US Army Corps of Engineers®
Engineer Research and Development Center

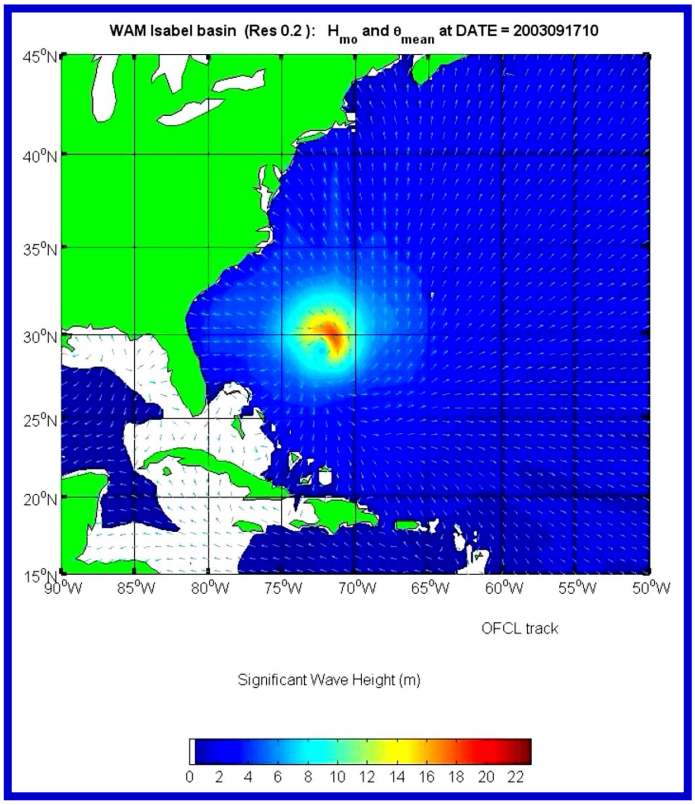
Wave Modeling

Description

ERDC's Coastal and Hydraulics Laboratory experts play a roll in solving problems in coastal engineering projects for USACE Districts, the National Weather Service, and various other agencies through numerical wave modeling. Waves are a unique feature of the coastal environment. Waves move sediments, erode shorelines, disrupt navigation, and excite harbor oscillations. Therefore, coastal engineering projects require wave information including generation of waves, transformation of waves over complex bathymetry, interaction of waves with currents and structures, and wave propagation in entrances and harbors.

Capabilities

CHL has a full suite of technologies to numerically model wave generation and transformation in the ocean and in enclosed basins. Wave modeling is broken into three scales: generation, transformation, and local.



Color contour plot of significant wave heights from Hurricane Isabel using WAM

- Generation Scale: Waves are generated on the scale of ocean basins or regions and the generation is driven by winds. These deepwater waves provide the offshore boundary conditions and climatology for beach, inlet, harbor, and channel projects. CHL has generated a hindcast of wave conditions for U.S. coasts called the **Wave Information Studies (WIS)**. This 40-year hindcast is archived and available on the Web. CHL also performs site-specific studies of wave climatology using the models **WAM** and **WISWAVE**.

- Transformation Scale: Waves transform in transitional and shallow-water depths due to interactions with the bottom. These nearshore waves provide the longshore and cross-shore variation in wave parameters required for design and maintenance of beach, inlet, harbor, and channel projects. CHL has developed the **STWAVE** model, which is a flexible, robust, numerical model that represents wave transformation over

complex bathymetry, wave-current interaction, local wave growth, and depth- and steepness-induced wave breaking.

- Local Scale: On a small or local scale such as a harbor, channel entrance, and around structures and islands, wave-phase dependent processes of diffraction, reflection, and nonlinear interaction become important. CHL has developed the **BOUSS-2D** and **CGWAVE** models for detailed wave stimulation at the local scale.

Supporting Technology

CHL has graphical user interfaces to generate model input, interface wave models to circulation and shoreline change models, and visualize model results. CHL also has the expertise to collect and analyze field measurements of waves and conduct physical model tests of wave processes.

Benefits

CHL's unique suite of wave technology provides efficient modeling at all scales. The emphasis is on solving practical problems through quick assessment in a cost-effective manner.

Success Stories

Time and money have been saved in hundreds of projects through the use of CHL's numerical models and databases. Recent projects include the following:

- Brunswick, GA, study of beneficial uses of dredged material using WIS and STWAVE
- Delong Mountain Terminal, AK, study of sediment movement into a channel using WAM and STWAVE for harbor design.
- Grays Harbor, WA, study of channel design for navigation using STWAVE
- Virginia Beach, VA, study the impact of shoal mining on the shoreline using STWAVE
- Sabine, TX, study of the impact of channel deepening on adjacent shoreline using WIS and STWAVE
- Grand Haven and Pentwater Harbors, MI, studies involving bank erosion and design of wave absorbers in harbor entrances using CGWAVE
- Brookings Harbor, OR, harbor oscillation and relocation of the harbor entrances design study using CGWAVE
- Kahului, HI, design study of harbor entrance, breakwaters and infrastructure modifications inside harbor using CGWAVE
- Guam, study of runup and overtopping flooding caused by wave transformation over a reef, using BOUSS-2D and CGWAVE
- Mississippi River Gulf Outlet, study of ship traffic management for river bank erosion caused by ship-induced waves using BOUSS-2D

Points of Contact

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